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Chemical Characteristics of Selected Rivers in Mainland Nova Scotia, 1985

D. Ashfield, G.J. Farmer and D.K. MacPhail

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Ashfield, D., G.J. Farmer and D.K. MacPhail. 1993. Chemical characteristics of selected rivers in mainland Nova Scotia, 1985. Can. Data Rep. Fish. Aquat. Sci. No. 913: v + 15 p.

Chemical characteristics of eight rivers located in mainland Nova Scotia were measured during 1985. Three of the rivers were sampled on two occasions, while the other five were sampled once. The chemical characteristics presented in this report can be examined to help determine the sensitivity of the rivers to acid precipitation, to facilitate the planning of salmon enhancement programs and to enable the selection of suitable release sites for hatchery-reared juveniles.

Key words: Atlantic salmon rivers, Nova Scotia, water chemistry, salmon enhancement.

RÉSUMÉ

On a évalué les caractéristiques physiques de huit rivières de la péninsule néo-écossaise en 1985. Cinq de ces rivières ont été échantillonnées une seule fois et les trois autres l'ont été à deux reprises. Les caractéristiques physiques étudiées peuvent servir à déterminer la vulnérabilité des rivières aux précipitations acides, à faciliter la planification des programmes de mise en valeur du saumon et à choisir de bons sites de mise à l'eau des juvéniles d'écloserie.

Mots-clés : rivières à saumon de l'atlantique, Nouvelle-Écosse, composition chimique de l'eau, mise en valeur du saumon.

INTRODUCTION

A number of mainland Nova Scotia rivers which drain to the Atlantic coast have become more acidic during at least the past 30 years in response to increased acid loading by precipitation (Watt et al. 1983). The most seriously acidified rivers are those found on bedrock composed of granite and/or greywacke, and in some rivers the native populations of Atlantic salmon have become extinct. Rivers which lie on slate have higher pH values, and the highest values are found for rivers which drain areas of carboniferous sediments. Watt et al. (1983) also demonstrated that the pH values of some rivers are inversely correlated with their rates of discharge, so that pH values are maximal during the late summer when discharge is lowest and minimal during the winter when discharge is usually greatest.

Prior to 1982, only limited information on the chemical characteristics of rivers in Nova Scotia was available. Thus, the chemical characteristics of fifty-six large rivers and nine smaller rivers were measured between 1982 and 1985 (Farmer et al. 1982, Ashfield et al. 1983 and 1984, and MacPhail et al. 1984 and 1985).

The chemical characteristics of three additional rivers were measured in 1985, once during a period of high discharge and once during low discharge. Five of the rivers previously sampled in 1982 were resampled on one occasion during 1985. Selection of the two sampling periods was made to gain insight into the ranges of pH which presently occur in the rivers. The major tributaries of the eight rivers were sampled to provide information on the chemical characteristics of each river's entire drainage area.

MATERIALS AND METHODS

Several sites on the Gaspereau, Stewiacke and Shubenacadie rivers were visited during May and again during August of 1985 to obtain water samples. In addition, water samples were collected during August of 1985 from various sites on the Liscomb, Clyde, Tusket, Carleton and Salmon rivers previously sampled in 1982 (Farmer et al. 1982). Samples were collected at each site in 500 mL polyethylene containers which had first been washed and then rinsed in deionized water. Samples taken for metal analyses were collected in 250 mL polyethylene containers which had first been washed in a 50% HNO_3 solution and then rinsed with deionized water. Each sample for metal analysis was preserved by the addition of 1 mL of 50% HNO_3 solution. All chemical analyses of river water were performed upon return to the laboratory. A Metrohm Herisau pH meter was used to determine the pH values of all sites within 24 hours of sampling. Total hardness, total alkalinity, chloride and sulfate were measured by using techniques outlined in Environment Canada (1981): total hardness as $CaCO_3$ by EDTA titration to Eriochrome Black T colour change; total alkalinity as $CaCO_3$ by potentiometric titration with H_2SO_4 to pH end points of 4.5 and 4.2; chloride by the automated thiocyanate method; and sulfate by titration with barium chloride after adding thorin indicator. Specific conductance was determined at 25°C by use of a Metrohm Herisau conductivity meter and apparent colour was measured with a Helige Aqua Tester. Concentrations of calcium, magnesium and aluminum were determined by emission spectrophotometer (Jarrel-Ash, AtomComp).

Flow rates of the Gaspereau River were measured on both sampling dates. An Ott current meter (Model C-1) was used to measure velocity at three equally spaced positions on a line delineating the width of the river. The propeller of the meter was adjusted at each position so that measurements were made at 0.6 of total depth. Flow rate was then estimated from the equation: $R = W.D.V$ where:

R = flow rate or volume
W = river width
D = river depth (average of 3 measurements)
V = water velocity (average of 3 measurements).

Flow rates of the other rivers in the study were not measured.

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Table 1. Some chemical characteristics of the Gaspereau River system during May and August, 1985.

Site	Site name	pH	Total alkalinity (mg/L)	Total hardness (mg/L)	Specific conductance (µs/cm)	Apparent colour (relative units)	Ca	Mg	Cl	SO_4	Al (µg/L)
							(mg/L)				
May 15											
A1	Above head of tide (flow-19.382 m^3/s)	6.63	5.3	11.8	47	40	2.7	1.1	7.1	4.3	40
A2	Black River	6.18	2.0	7.4	35	40					
A3	Above White Rock (flow-5.611 m^3/s)	6.52	4.0	10.4	49	55					
A4	Outflow from Gaspereau Lake	5.95	1.5	5.9	34	40					
A5	North River	4.99	<0.5	3.9	29	110					
August 20											
A1	Above head of tide (flow[1]-2.598 m^3/s)	6.22	2.2	5.4	30	55	1.5	0.7	4.4	2.6	200
A2	Black River	6.00	1.5	5.3	29	50					
A3	Above White Rock (flow-0.752 m^3/s)	6.60	4.5	8.5	38	30					
A4	Outflow from Gaspereau Lake	5.98	0.9	4.8	28	30					
A5	North River	5.42	<0.5	4.9	30	55					

Table 2. Some chemical characteristics of the Stewiacke River system during May and August, 1985.

Site	Site name	pH	Total alkalinity (mg/L)	Total hardness (mg/L)	Specific conductance (µs/cm)	Apparent colour (relative units)	Ca	Mg	Cl	SO_4	Al (µg/L)
							(mg/L)				
May 16											
B1	Above head of tide	6.52	4.5	25.7	80	25	8.7	0.9	5.6	18.1	50
B2	Fisher Brook	5.20	<0.5	6.7	27	110					
B3	Little River	6.91	12.8	44.1	133	40					
B4	Rutherford Brook	6.44	3.2	8.4	33	30					
B5	Chapman Brook	6.48	3.3	24.9	73	30					
B6	Otter Brook	6.61	5.6	43.6	129	25					
B7	South Branch Stewiacke River	6.20	4.3	27.0	80	40					
B8	Pembroke River	6.52	3.7	13.2	43	20					
B9	Newton Brook	6.36	2.1	9.8	49	20					
B10	Big Stewiacke River	5.78	0.7	3.7	20	15					
B11	Sutherland Brook	5.73	0.5	3.4	19	15					
B12	Above Sutherland Brook	5.97	0.7	3.7	22	15					
August 19											
B1	Above head of tide	7.10	15.3	72.5	211	20	25.8	2.2	14.0	51.2	<25
B2	Fisher Brook	6.10	3.9	21.5	58	200					
B3	Little River	7.69	43.4	145.0	364	40					
B4	Rutherford Brook	6.99	10.2	20.6	63	15					
B5	Chapman Brook	6.67	17.6	103.9	239	10					
B6	Otter Brook	6.90	20.7	137.2	613	5					
B7	South Branch Stewiacke River	6.95	13.9	88.2	203	15					
B8	Pembroke River	6.92	10.4	41.6	121	10					
B9	Newton Brook	6.66	5.1	26.3	97	10					
B10	Big Stewiacke River	6.28	1.2	4.7	25	5					
B11	Sutherland Brook	5.76	1.0	4.4	36	5					
B12	Above Sutherland Brook	6.46	2.9	5.9	33	15					

Table 3. Some chemical characteristics of the Shubenacadie River system during May and August, 1985.

Site	Site name	pH	Total alkalinity (mg/L)	Total hardness (mg/L)	Specific conductance (µs/cm)	Apparent colour (relative units)	Ca	Mg	Cl	SO_4	Al (µg/L)
							(mg/L)				
May 16											
C1	Above head of tide	6.71	7.4	45.1	145	40	16.2	1.4	12.2	29.0	210
C2	McLean Brook	6.68	6.6	65.2	166	40					
C3	Gays River	6.90	9.5	76.4	190	20					
C4	South Branch Gays R.	6.78	6.9	76.0	186	40					
C5	Ervin Brook	6.84	8.6	58.8	159	25					
C6	Nine Mile River	6.90	8.6	37.2	119	60					
C7	At Elmsdale	6.54	0.5	21.1	110	15					
C8	Bennery Brook	4.72	<0.5	23.7	157	15					
C9	Outflow from Kinsac Lake	5.78	0.6	8.2	49	25					
August 19											
C1	Above head of tide	6.63	21.5	69.4	218	25	25.5	1.9	13.7	44.0	240
C2	McLean Brook	7.39	33.3	245.0	500	15					
C3	Gays River	7.28	26.8	259.7	514	25					
C4	South Branch Gays R.	7.54	38.2	441.0	826	25					
C5	Ervin Brook	6.99	18.5	115.6	268	20					
C6	Nine Mile River	8.10	46.0	166.6	407	15					
C7	At Elmsdale	6.33	2.7	14.7	85	10					
C8	Bennery Brook	4.75	<0.5	45.6	252	5					
C9	Outflow from Kinsac Lake	6.19	1.3	8.2	52	20					

Table 4. Some chemical characteristics of the Salmon River system during August, 1985.

Site	Site name	pH	Total alkalinity (mg/L)	Total hardness (mg/L)	Specific conductance (µs/cm)	Apparent colour (relative units)	Ca	Mg	Cl	SO_4	Al (µg/L)
							(mg/L)				
August 22											
A1	Above head of tide	5.55	0.7	8.3	60	110					
A2	Felix Mill Brook	5.18	<0.5	7.8	59	110					
A3	Indian River	5.65	0.8	7.5	55	30					
A4	Below Lake George	5.51	0.6	6.4	51	10					
A5	Blackwater Brook	5.29	<0.5	8.1	54	200					
A6	Dean Brook	5.38	0.5	7.4	49	220					
A7	Below Salmon River Lake	5.47	0.5	6.2	46	50					
A8	Swallow Lake Brook	5.37	0.5	6.7	46	120					

Table 5. Some chemical characteristics of the Carleton River system during August, 1985.

Site	Site name	pH	Total alkalinity (mg/L)	Total hardness (mg/L)	Specific conductance (µs/cm)	Apparent colour (relative units)	Ca	Mg	Cl	SO_4	Al
							(mg/L)				(µg/L)
August 27											
B1	Below Raynards Lake	6.07	1.7	7.4	47	50					
B2	Below Lake Fanning	5.89	1.2	7.3	45	40					
B3	Below Rounding Lake	5.80	0.9	6.9	44	55					
B4	Below Parr Lake	5.79	1.5	7.2	45	70					
B5	Salmon Lake Brook	5.38	0.6	5.4	40	70					
B6	Below Briar Lakes	5.55	0.6	6.4	44	70					
B7	At Richfield	5.68	1.0	6.6	42	75					
B8	Below Wentworth Lake	5.56	0.7	6.5	43	110					
B9	Seven Pence Half Penny Brook	5.32	0.5	6.4	41	140					
B10	Below Sullivans Lake	5.59	0.8	6.8	42	110					
B11	Bear Lakes Brook	5.44	<0.5	5.7	40	40					
B12	Seven Pence Halfpenny Brook[1]	5.40	1.2	6.0	40	280					
B13	Seven Pence Halfpenny Brook	4.46	<0.5	3.4	46	220					
B14	Above Wentworth Lake	5.72	2.7	8.6	50	60					
B15	Below Porcupine Lake	5.96	3.2	8.8	51	60					
B16	At Havelock	5.82	4.2	11.8	60	140					

1. Limestone treatment

Table 6. Some chemical characteristics of the Tusket River system during August, 1985.

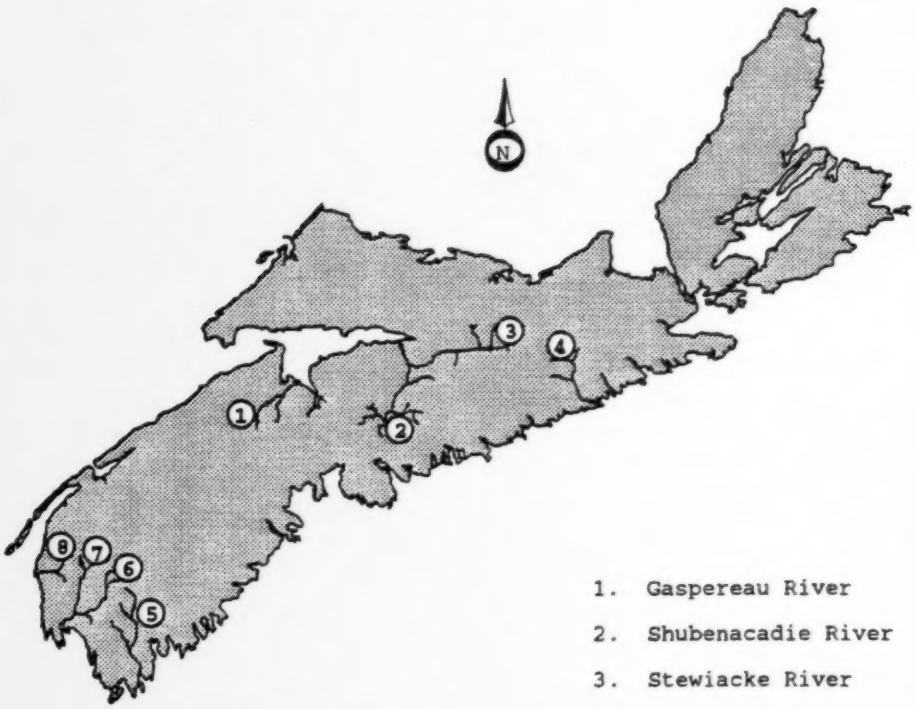
Site	Site name	pH	Total alkalinity (mg/L)	Total hardness (mg/L)	Specific conductance (µs/cm)	Apparent colour (relative units)	Ca	Mg	Cl	SO_4	Al
							(mg/L)				(µg/L)
August 26											
C1	Tusket Falls	5.12	<0.5	5.1	39	100					
C2	Sommes Lake Brook	5.82	1.8	7.1	42	30					
C3	Mill Lake Brook	5.77	1.7	6.3	45	20					
C4	Below Quinan River	4.98	<0.5	4.2	39	110					
C5	Quinan River	4.89	<0.5	4.4	40	75					
C6	Quinan River	5.00	<0.5	4.4	40	75					
C7	Mespark Brook	4.79	<0.5	4.9	45	80					
C8	Below Kegeshook Lake	4.86	<0.5	3.9	35	120					
C9	Above Pearl Lake	4.78	<0.5	3.9	40	140					
C10	East Branch Tusket R.	4.75	<0.5	3.3	36	140					
C11	Big Meadow Brook	4.76	<0.5	4.0	36	140					
C12	Bear Lakes Brook	4.42	<0.5	1.8	37	200					
C14	Whistler Brook	4.67	<0.5	4.2	43	260					

Table 7. Some chemical characteristics of the Clyde River system during August, 1985.

Site	Site name	pH	Total alkalinity (mg/L)	Total hardness (mg/L)	Specific conductance (µs/cm)	Apparent colour (relative units)	Ca	Mg	Cl	SO_4	Al
							(mg/L)				(µg/L)
August 9											
D1	Above head of tide	4.40	<0.5	2.6	43	240					
D2	Bloody Creek	4.40	<0.5	3.1	45	260					
D3	Hamilton Branch	4.40	<0.5	3.0	44	240					
D4	Salmon Creek	4.46	<0.5	2.7	40	240					
D5	Hemlock Creek	4.38	<0.5	2.5	46	360					
D6	Clyde River at Briar Hill	4.46	<0.5	2.4	39	220					
D7	Rory Lake, Davis River	4.22	<0.5	2.9	50	480					

Table 8. Some chemical characteristics of the Liscomb River system during August, 1985.

Site	Site name	pH	Total alkalinity (mg/L)	Total hardness (mg/L)	Specific conductance (µs/cm)	Apparent colour (relative units)	Ca	Mg	Cl	SO_4	Al
							(mg/L)				(µg/L)
August 7											
Q1	Above head of tide	5.09	<0.5	3.5	24	130					
Q2	Hardwood Lake Brook	4.88	<0.5	3.0	24	130					
Q3	Little Liscomb River	5.13	<0.5	3.1	24	110					
Q4	Below Ladle Lake	5.26	<0.5	3.3	21	70					
Q5	Below Big Brook Lake	5.93	1.5	3.9	21	20					
Q6	Below Rush Lake	5.08	<0.5	3.5	24	75					



1. Gaspereau River
2. Shubenacadie River
3. Stewiacke River
4. Liscomb River
5. Clyde River
6. Tusket River
7. Carleton River
8. Salmon River

Figure 1. Location of rivers included in the sampling program.

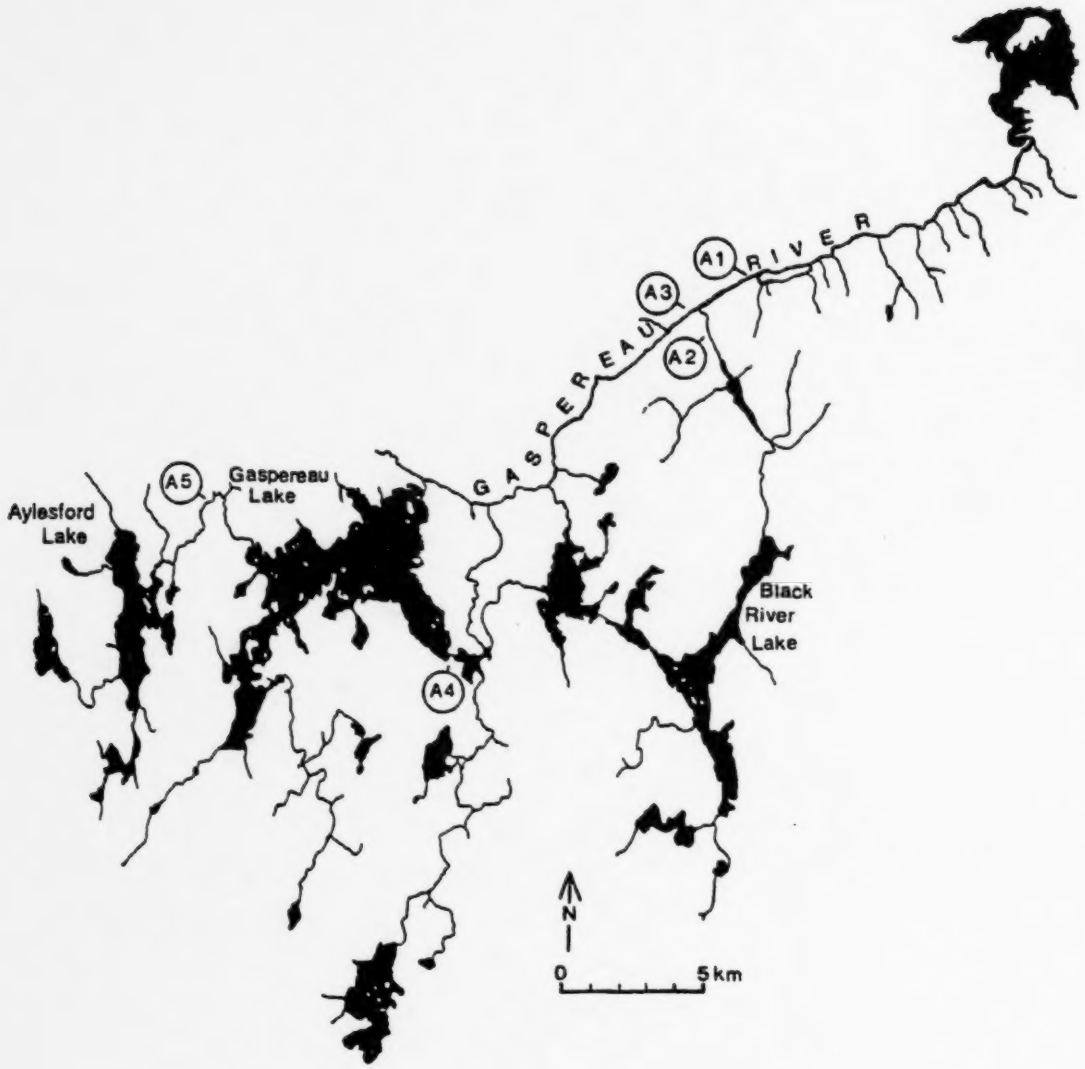


Figure 2. Water sampling sites on Gaspereau River.

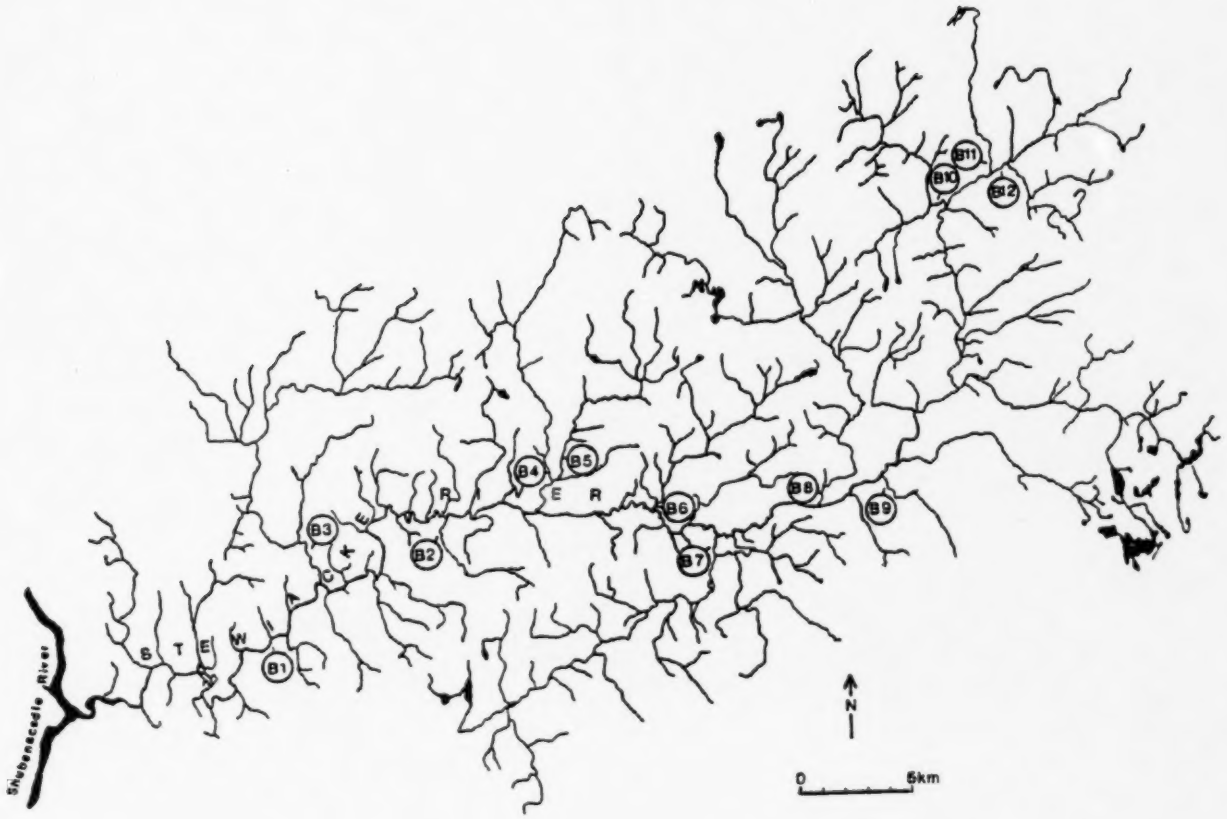


Figure 3. Water sampling sites on Stewiacke River.

Figure 4. Water sampling sites on Shubenacadie River.

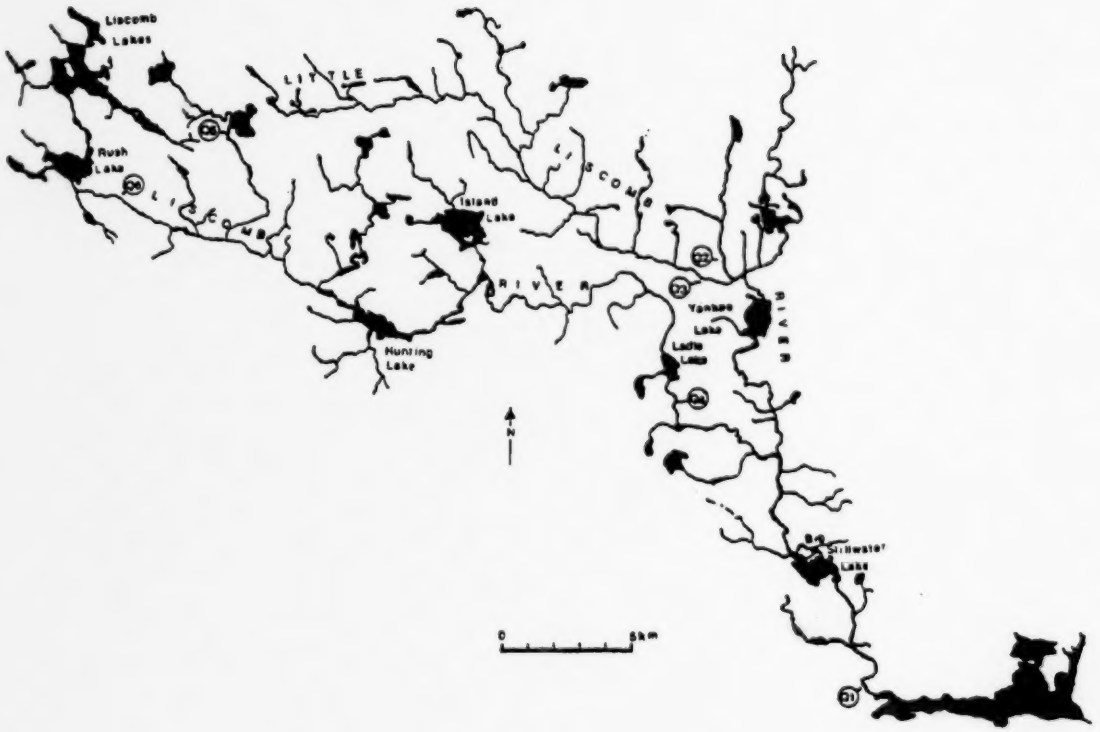


Figure 5. Water sampling sites on Liscomb River.

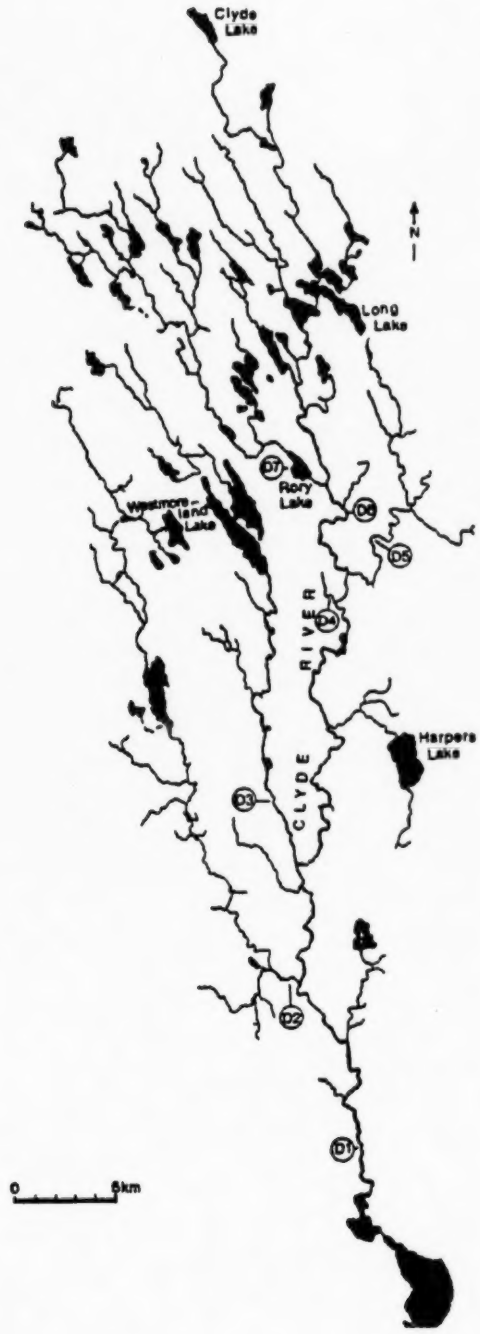


Figure 6. Water sampling sites on Clyde River.

Figure 7. Water sampling sites on Tusket River.

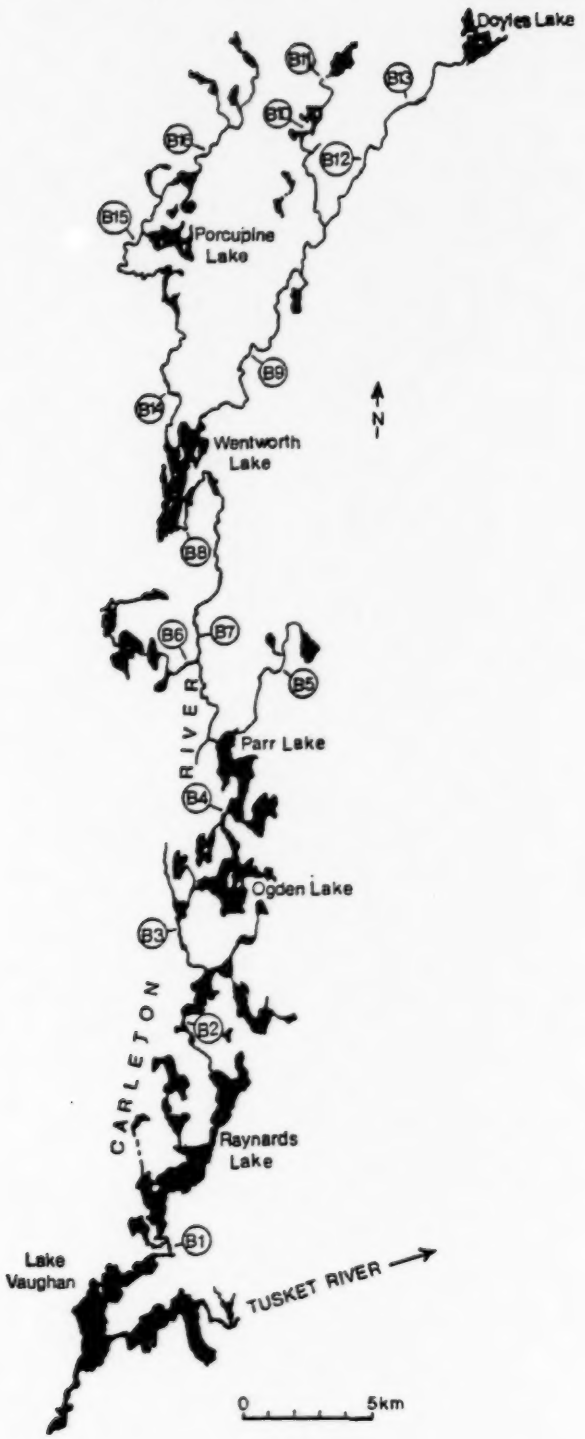


Figure 8. Water sampling sites on Carleton River.

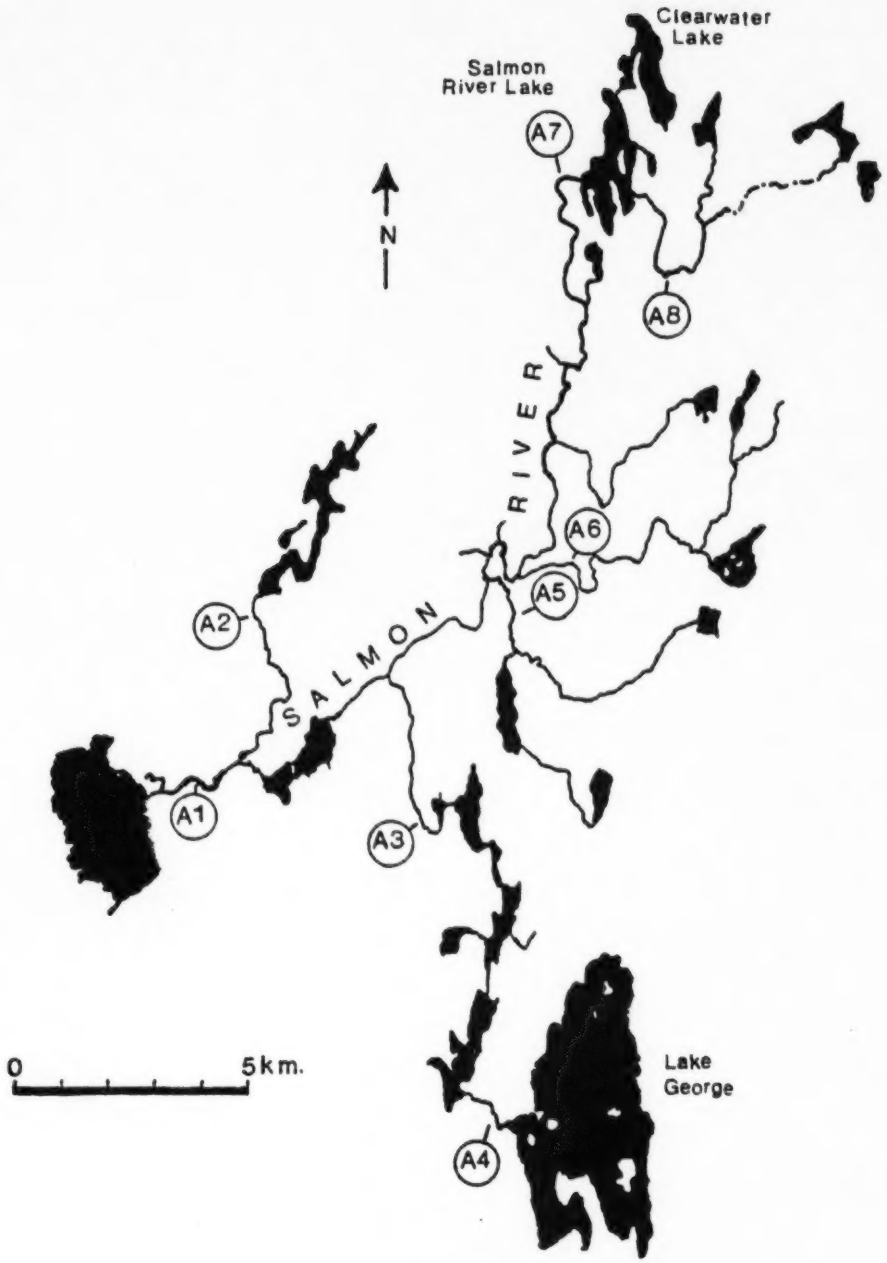


Figure 9. Water sampling sites on Salmon River.